CONTINUING ROLE OF AROIDS IN THE ROOT CROP-BASED CROPPING SYSTEM OF TONGA

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Abstract

For many generations, taro, together with other root crops, has been a major component of the traditional cropping system in Tonga and is its most important staple.

The increasing problem of land shortage has resulted in a gradual change in the traditional cropping system, reducing the bush fallow to a minimum and replacing some root crops with vegetables.

Susceptibility to drought has recently caused a marked decrease in taro production. In addition, the introduction of more attractive short-term cash crops has slowly caused taro to be replaced in their cropping system.

This paper discusses the continuing important roles of taro either in a root crop based multiple cropping system or as a possible cash monocrop.

Introduction

The Kingdom of Tonga comprises some 150 islands, of which only 36 are inhabited by its present population of about 100,000. The total land area of 269 square miles is spread between 173° and 177° west longitude and 15° and 23° south latitude. Tonga has a warm oceanic climate, with rainfall averaging 1,500-2,000 mm per annum and temperature averaging 26°C. Both rainfall and temperature increase from south to north.

Importance of Root Crops in Tonga

Root crops make up a major component of the island cropping system. Today, root crops are still the main staple food, a measure of social status and prestige, and have become important in both internal and external trade. In fact, over 90 percent of the population depends on root crops for survival.

The customary presentation to royalty and nobility is also based on a number of root crops, with yams (*Dioscorea alata*) and *Alocasia macorrhiza* being the most important.

Traditional Cropping System

Traditionally, the farmer follows a multiple cropping system, practicing shifting cultivation. Basically, there is one general cropping cycle, but it is highly modified to suit individual preferences, soil types, time, and location. A six-year crop rotation is generally practiced in the following sequence: yam + giant taro (8-12 mos) - sweet potato (5-6 mos) - taro (8-12 mos) - cassava (6-8 mos) - bush fallow (2-4 yrs).

A new piece of land is planted with yams, almost always intercropped with giant taro (*Alocasia*) and a few plantains or bananas. Recently, *Colocasia*, maize, and other leafy vegetables are frequently included in intercropping with yams. When yam is harvested, one can according to preference either plant taro or sweet potato. When sweet potato is harvested, taro (either *Colocasia* or *Xanthosoma*) is planted. Cassava is grown last in the cycle because it is known to be better in soils of low fertility. After the cassava crop, the area is allowed to go into two to four years of bush fallow. In recent years, more crops such as vegetables are incorporated into the cycle and various combinations are noted, although they all seem to follow the pattern shown above.

With the increasing problem of land shortage and the shift from subsistence agriculture through semi-subsistence to commercial agriculture, the practice of monocropping is gradually replacing multicropping and the traditional cropping system is slowly changing. The land shortage problem has also forced the bush fallow period to a very bare minimum. With improved technologies, better cultural practices, and the use of a good rotation system, this is made possible.

The use of fertilizers on root crops has been a hard concept for farmers to adopt, but in a suitable rotation, fertilizers can be applied to root crops indirectly (e.g., use of fertilizer on a crop of watermelon before a crop of taro or yams).

Importance of Edible Aroids in Tonga

There are three edible aroids cultivated in Tonga, and they are all important in the staple diet. They are: *Alocasia macrorrhiza, Colocasia esculenta* var. *esculenta,* and *Xanthosoma sagittifolium.*

Alocasia is ranked with the highest social value of the three as it can take the place of yams when presented to royalty, nobility, and in traditional feast tables. *Colocasia*

is ranked next as it can be presented on traditional feast tables. *Xanthosoma* is not acceptable on traditional feast tables; however, it is the second most consumed staple food after cassava.

Of the three aroids present in Tonga, *Xanthosoma* is the most widely grown one, followed by *Alocasia* and *Colocasia*, respectively.

Tables 1 and 2 show the quantity and value of root crop exports during the years 1985-1989. Percentage of each crop is also given. Table 2 shows that although the value of the root crops was increasing during these years, there was a general decrease in the percentage of agricultural exports when compared to the country's total exports during these years.

Table 3 shows that the supply of root crops to the local market was increasing during the last two years and the percentage of aroids seem to be decreasing.

Table 1. Quantity (kg) of root crop exports, 1985-1989.

Crops	1985	1986	1987	1988	1989
Yam	427,544	206,972	509,826	257,370	302,794
Colocasia	114,004	5,257	9,199	15,496	3,115
Xanthosoma	488,003	103,864	276,668	120,342	660,624
Alocasia	77,968	35,538	46,467	50,858	334,160
Cassava	36,801	960	117,567	722,192	424,050
Mixed root crop	--	28,577	93,252	66,606	138,041

Table 2. Value (T$) of root crop exports and its percent of total agricultural exports, 1985-1989.

Crop	1985	1986	1987	1988	1989
Yam	169,405	105,888	388,195	253,379	505,008
%	3.09	1.60	6.57	4.85	7.03
Colocasia	29,520	2,687	4,448	12,933	3,010
%	0.54	0.04	0.08	0.25	0.04
Xanthosoma	152,340	46,428	147,961	99,268	559,554
%	2.78	0.70	2.51	1.90	7.79
Alocasia	49,666	32,826	30,888	50,640	209,646
%	0.91	0.50	0.52	0.97	2.92
Cassava	8,328	350	39,007	157,584	176,350
%	0.15	0.01	0.66	3.01	2.46
Mixed roots	24,364	13,023	46,272	47,628	120,206
%	0.44	0.20	0.78	0.91	1.67
Total	433,623	201,202	656,769	621,450	1,576,471
%	7.91	3.04	11.12	11.89	21.92
Percent of agricultural export to total country export	76.50	76.09	67.08	55.02	62.34

Table 3. Supply (tons) of root crops to Talamahu market, 1987-1991.

Crop	1987	1988	1989	1990	1991
Yam	325.91	215.92	294.62	313.56	349.88
Colocasia	15.68	19.30	33.68	222.05	187.21
Xanthosoma	357.92	230.11	493.35	1,184.09	887.40
Alocasia	707.29	112.34	252.94	196.22	158.26
Cassava	714.53	740.11	695.36	389.51	438.02
Sweet potato	818.58	399.52	809.79	1,861.84	1,818.29
Total	2,949.9	1,717.3	1,778.9	4,167.3	3,939.1
Percent aroids to root crops	36.6	21.1	43.8	38.5	31.3

Problems of Aroid Production in Tonga

Although figures in Tables 1, 2, and 3 show that there was a general decrease in the production of root crops and, in particular, aroids, it does not indicate a similar decline in its importance. Aroids still maintain importance in the staple diet, in social value, and in internal and external trade.

The main reason for the decrease in the production of aroids (and other root crops) was the introduction of squash as a new export crop. During the last five years, a "squash rush" occurred in the Kingdom, when almost every farmer of all categories and levels suddenly turned around and produced squash. Squash was very attractive because of its very high return within a period of three months.

The effects of this "squash rush" on root and other crops were twofold:

Many farmers who have been producing root crops for years have now become converted squash farmers. The cultivation of squash is so intensive in all aspects that many farmers cannot afford to produce any other crop during the three to six months. All his resources, time, and concentration are focused on squash.

Acres which used to be under root crops are now converted to squash because farmers say, "It is more productive this way."

Besides these general problems facing the aroids, each crop has its own problems in production:

Alocasia is confined to a planting season of May-October, planting during other times results in very hard inedible stems that sometimes contains very high amounts of calcium oxalate making it unsuitable for consumption. Observations have also shown that use of fertilizers increases yield, but affects the eating quality.

Colocasia is the best tasting of the three aroids. However, it has the disadvantage that it is very susceptible to droughts. During the last five years, production has dropped dramatically due to drought problems, resulting in a marked decrease in planting materials for the following seasons.

Xanthosoma is probably the most hardy of the three aroids and withstands droughts better than *Colocasia*, but prolonged droughts of 2 to 4 months can also affect the yield of *Xanthosoma*. It can be stored longer in soil without affecting the eating quality. The disadvantage of *Xanthosoma* is that it takes at least 12 months to mature and farmers prefer to grow more short-term crops like sweet potato.

Efforts to Retain the Aroids' Important Roles

In the Ministry of Agriculture and Forestry's future plans, *Colocasia* is one of the crops it wants to concentrate on. Export markets are good, and the local market demand is also high.

In our research programs, we have made recommendations about the cultivation of the crop, including the most appropriate cultural practices. However, because the local germplasm is very limited, we have started bringing in materials in tissue culture and have started to test them with local cultivars.

One of the long-term objectives of the project is to start a breeding program to select materials which show resistance to drought with high yields, good eating quality, and good agronomic characteristics.

The first step, however, is for us to mass multiply the best materials we now have in nursery and tissue culture and make them available for farmers. This will ensure initially an increase in the acreage of taro in the country. In the meantime, we continue to evaluate imported materials in the field, and once they are selected, we

multiply and release them to farmers. By doing this, we are sure that aroids, especially *Colocasia*, will come back again as a major component of the cropping system or become a competitive monocrop and an important cash crop.

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